3.2 SIGNATURE RADAR CROSS SECTION

The radar cross section (RCS) of a target is a measure of the proportion of the incident energy reflected back to the radar. This energy varies with target geometry and orientation as well as the frequency and polarization of the radar. Several target RCS files are distributed with *RADGUNS*. The user may also generate RCS files in one of three formats accepted by *RADGUNS* (see the *RADGUNS* Users Manual for a detailed description of file formats). Target returns are computed for a particular target aspect by linearly interpolating between the data points surrounding the given aspect, for the frequency and polarization closest to those of the system selected. For rotary aircraft, the user may also specify blade RCS, length, and rotation rate. Each blade (regardless of length) is divided into 32 segments, each with an associated radial velocity. A composite blade return is calculated and added to the body return.

Detection range in *RADGUNS* is dependent on the target and clutter returns and is computed using the radar range equation. All other parameters in the range equation are system specific, and are modeled as constants (i.e. radar wavelength and signal-to-noise threshold).

3.2.1 Objectives and Procedures

Excluding clutter and multipath returns, detection range is a direct function of target RCS for a given set of radar parameters. This analysis will examine the effect of target RCS on detection range. *RADGUNS* was executed with the following input conditions:

a. Model mode: SINGL/RADR
b. Radar type: RAD1
c. Search type: PERC
d. MTI switch: OFF
e. Flight Path: Low altitude linear pass, no offset

To determine the effect of blade RCS, length, and speed on target detection, *RADGUNS* was executed with the following input conditions:

a. Model mode: SINGL/RADR
b. Target presented area: Representative attack helicopter
c. Target RCS: Representative attack helicopter
d. Target speed: Stationary
e. Radar type: RAD1
f. Search type: PERC
g. MTI switch: ON
h. Number of blades: Two

3.2.2 Results - Body Returns

Figure 3.2-1 shows the relationship between target RCS and detection in the absence of clutter, multipath, or other noise factors for a particular system.

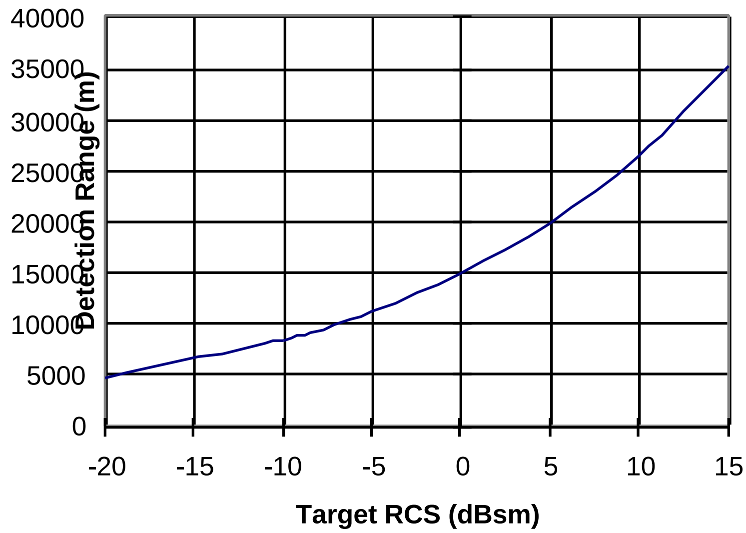

FIGURE 3.2-1. Detection Range as a Function of Radar Cross Section.

3.2.3 Results - Blade Returns

With the MTI switch in the OFF position, the maximum detection range for the helicopter body only (blade length, RCS, and rotation rate set to zero) was determined. When held stationary well within this range, the helicopter was not detected with the MTI switch in the ON position. A blade return was then added by setting a nominal blade length of 6.7 meters and a rotation rate of 40 RPM. At RCS values above -16.7 dBsm, the helicopter was detected. The blade rotation rate was then varied with a nominal RCS of -15 dBsm and a blade length of 6.7 meters. For all rotation rates above 26.2 RPM, the helicopter was detected. Next the blade length was varied with the nominal RCS value and a high rotation rate. For blade lengths shorter than 0.6 meters, the helicopter was not detected.

3.2.4 Conclusions

Detection ranges in *RADGUNS* are computed by the radar range equation. Detection range varies with the fourth root of RCS as shown in Figure 3.2-1. *RADGUNS* is moderately sensitive to changes in RCS. This principle applies to blade returns as well. *RADGUNS* divides each blade into 32 segments (regardless of blade length), each segment with a different radial velocity (the radial velocity of the blade tip is higher than that of the base). The blade return is the summation of the individual segment returns. The helicopter return is the summation of the body and blade returns. For a hovering helicopter with the MTI in the OFF position, the body return will drive detection. When the MTI is in the ON position, however, the body return will be canceled, and the blade return will drive detection. Blade length and rotation rate do not significantly affect detection. Once the radial velocity of any of the blade segments (determined by a combination of blade length and rotation rate) is above the first notch in the MTI response, the helicopter will be detected. Thus, detection range is relatively insensitive to changes in blade length or rotation rate.